Migration Chronology, Routes, and Winter and Summer Range of Pacific Flyway Population Lesser Sandhill Cranes

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Final Report

Managers of migratory game birds require increasingly more information about bird movements to delineate populations, protect important habitats, and regulate harvest. Detailed information describing movements of sandhill cranes belonging to the Pacific Flyway Population (PFP) are lacking. We used satellite telemetry to monitor movements of PFP lesser sandhill cranes captured in Alaska.

Twelve satellite transmitters were deployed on flightless young (colts) at 4 locations in upper Cook Inlet (Palmer Hay Flats, Anchorage Coastal Wildlife Refuge, Susitna Flats, Point McKenzie) in 2000 and 2001, and 7 satellite transmitters were deployed on colts in Bristol Bay (Nushagak Peninsula) in 2002 (Fig. 1). Colts were captured with the aid of a Robinson 22 helicopter. When a family group was observed from the air, the pilot hovered the aircraft over a colt at approximately 1m AGL allowing a person to exit the aircraft, capture, and restrain the bird. Only one colt per family group was captured. At the capture site we sampled blood for sexing and future genetics analysis. Sex ratios of colts were ca. 50:50 (10 males and 9 females).

We attached a satellite transmitter with a leg-band attachment (Melvin et al. 1983, Ellis et al. 2001) above the tibio-tarsal joint with the stainless steel antenna pointing down. To the other leg we applied a USFWS metal leg band and a yellow leg band (50mm tall) with a unique alphanumeric code for identification in the field. Morphological characteristics were measured and recorded. On average, colts weighed 2.4 kg (SD ± 0.34kg). After release, the colt immediately reunited with adults waiting nearby for all but 2 captures.

Additionally, three satellite transmitters were deployed on adult cranes at a spring staging area in upper Cook Inlet, AK (Matanuska Valley) on 27 April 2002. Adult cranes were captured with the use of a rocket net over bait. Marking and processing protocol used for adults followed those used for colts.

Each satellite transmitter weighed approximately 55g (with band attachment), was programmable, and was manufactured with ambient temperature and battery voltage

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sensors (Microwave Telemetry, Inc.). Transmitter signals were received by 4 National Oceanic and Atmospheric Association (NOAA) polar-orbiting satellites. Signals were analyzed using Argos Data Collection and Location Systems.

Because satellite transmitters did not transmit continuously we can only report locations acquired during the transmission cycle. To provide a comprehensive description of the migration route used by PFP cranes while at the same time maximizing battery life, we programmed our satellite transmitters to transmit more frequently during migration than other times of the year. Nevertheless, stopping areas used by cranes for brief periods may have gone undetected, and the precise route taken during migration may not be apparent for cranes that traveled long distances between transmission cycles. For similar reasons, the number of days reported for cranes while in route and spent at stopping areas was approximated; accuracy being dependent on the number of hours during the off-cycle.

To reliably illustrate crane distribution on winter and summer range only the best location per transmission cycle (regardless of class code) was used. However, all acceptable locations per transmission cycle were used to illustrate migration routes because locations were frequently obtained during active migration.

RESULTS

Not all satellite transmitters provided useful information. Three birds were depredated soon after capture, one bird was shot during the hunting season in early September, and for one bird the transmitter failed for unknown reasons soon after capture (Table 1).

Seventeen satellite transmitters provided informative location data. However, 3 of these went off the air prior to the expected life of the transmitter, and 5 were deployed on cranes that either died or shed the transmitter during migration (Table 1).

Satellite transmitters applied with a leg band attachment provided ample location data even with the antenna pointing towards the ground, and had the potential to remain active for over a year (Table 1).

Fall Migration

Coastal route: PFP cranes began their southerly migration in early September (Table 2). Cranes departed Bristol Bay and traveled east where they potentially mix with Cook Inlet cranes (Fig. 1). They continued east and accessed the Gulf Coast of Alaska by flying directly over the Kenai Peninsula and through Prince William Sound (Fig. 1). PFP cranes captured in upper Cook Inlet accessed the Gulf Coast by traveling southeast over the Chugach Range. Once reaching the Gulf coast in south central Alaska, upper Cook Inlet and Bristol Bay cranes followed the coastline in a southeasterly direction (Fig. 1). At Pt.

Petrula

Spencer PFP cranes left the outer coast and continued migration through the islands and straits of the Alaska panhandle (Fig. 1).

We identified 5 stopping areas in Alaska frequently used by cranes during fall migration: the Yakutat Forelands; the Bering Glacier lowlands; the Stikine River Delta: the Copper River Delta, and Gustavus (Fig. 1). Cranes remained at Gustavus for the longest duration followed by the Yakutat Forelands.

Interior route: Near the Stikine River Delta, PFP cranes migrated inland and entered central British Columbia near Stewart then continued south through the Fraser River and Okanogan Valleys (Fig. 1). Because most cranes spent little time in British Columbia, stopping areas were used for brief periods and only a few could be reliably identified. Locations near Smithers, and Kamloops were used more frequently (Fig. 1), however, one crane spent ca. 14 days near Prince George.

PFP cranes continued south staying west of the Selkirk Mountains and entered north central Washington near Oroville (Fig. 1). The primary stopping area was in central Washington in the vicinity of the Potholes Reservoir (Fig.1) where 71% of radioed cranes spent, on average, 5.5 days (range=1-13). PFP cranes continued migration through central Oregon, spending little time in this state before entering California (Table 2). Few locations were obtained while cranes were in Oregon and most of those were for actively migrating birds (Fig. 1). Cranes traveled directly to wintering areas once entering California.

On average, it took approximately 27 days (range=13-44 days) for PFP cranes to complete the ca. 3,600-km migration from summer range in Alaska to winter range in California (Table 2). The maximum distance traveled by cranes calculated for individual flight segments indicates that cranes can attain an average flight speed of up to ca. 78 km/hr when actively migrating.

Winter Range

On average, PFP cranes arrived on wintering grounds in the Central Valley of California (CVC), on 7 October (range=19 Sep.-20 Oct.) (Table 2) spending the winter at 2 primary locations (Fig. 1). Fifty six percent of the total locations from 9 radioed cranes were in the Sacramento – San Joaquin River Delta (Delta) (Table 3), with the majority (63%) concentrated on Staten Island, Tyler Island, Canal Ranch, Brack Tract, Terminous Tract and New Hope Tract. Ninety four percent of locations in the Delta region were within a core area that encompassed 425 km^2.

Thirty five percent of the total winter locations from 6 radioed cranes were ca. 130km to the south in Merced County (Table 3), with most occurring between state highways 140 and 33/52 near Sandy Mush Country, in the Kesterson, San Luis and Merced National

Wildlife Refuges, and the Los Banos and Volta State Wildlife Areas. The core area used by cranes included 94 % of the total locations in this region and encompassed 1473 km^2.

Nine percent of the total winter locations from 4 cranes were outside the two primary wintering areas. However, only 2 cranes were located in these peripheral areas for >1 duty cycle. One was located in the vicinity of Vernalis near the San Joaquin River at the border of Stanislaus and San Joaquin Counties for 7 consecutive duty cycles (ca. 30 days) and another was located on the Pixley National Wildlife Refuge, north of Delano, for 27 consecutive duty cycles (ca. 83 days) (Table 3).

Winter locations obtained for individual PFP cranes were generally localized. Of the 10 radioed cranes monitored throughout the winter, location data for 2 cranes indicated that they did not move substantial distances from the general vicinity of their primary wintering area during the winter period (Table 3). Crane 29503 remained in the Delta region within a home range of approximately 371 km^2 and crane 13386 remained in Merced County, but 5 locations in Madera County extended its home range to 2,332 km^2. (Table 3). Seven cranes spent little time (<13% of their winter locations) away from their primary wintering area. Most (69%) movements were between primary wintering areas (Delta and Merced) with no apparent trend with respect to timing or direction of travel. Approximate home ranges of individual cranes averaged 168 km^2 (SD=132 km^2) in the Delta region (range=7-371 km^2) and 1,021 km^2 (SD=942 km^2) in Merced County (range=67-2,332 km^2) (Table 3).

Spring Migration

We obtained location data for 10 cranes during spring migration (Fig. 2). PFP cranes began migration north from winter range in the CVC in early March with first movements beginning 9 March (on average) (Table 2). The travel route north used during the spring was similar to that used in the fall (Fig. 2), but took approximately twice as long to complete ($\bar{x}$ =58 days) (Table 2). PFP cranes spent an average of 45 days at staging areas in the Pacific Northwest before continuing north. The Harney Valley in Oregon, and the Potholes Reservoir and Banks Lake regions in Washington were the most frequently used stopping areas in those states. Two cranes traveled further east than expected based on the observed fall migration route and spent significant time (≥35 days) near the Oregon and Idaho border in the vicinity of Fruitland and Wilder, Idaho before entering Washington (Fig 2). Stopping areas in British Columbia and Alaska used during the spring were similar to those used during the fall, however relatively less time was spent traveling through Alaska in the spring. PFP cranes arrived on their summer range during the first week of May ($\bar{x}$ =6 May).

Summer Range

Adults: Adult cranes captured during late April at a spring staging area in the Matanuska Valley, AK remained near the capture site for approximately 10 days before dispersing to breeding areas in the Susitna and Kahiltna river drainages (Fig. 2). Locations indicated little movement throughout the summer therefore we presume nest sites were initiated in this boreal forest, muskeg habitat. Transmitters on 2 adults failed just prior to anticipated fall migration. Location data for a male (33092) indicated the bird visited the capture location (staging area) the following spring then returned to summer in the same general location (Susitna River Valley) as the previous year (Fig. 2).

Colts: Between fledging and fall migration PFP cranes captured as flightless young remained relatively close to capture locations until migrating south. The following spring colts captured in upper Cook Inlet exhibited varying degrees of philopatry to natal sites. Only one crane returned to the immediate vicinity of its natal site, 4 cranes (2 males, 2 females) returned to upper Cook Inlet but did not revisit their natal location, and 2 cranes spent the summer outside the Cook Inlet region. Both cranes captured in Bristol Bay that remained on the air throughout the winter returned to the Nushagak Peninsula in the spring, but frequented other locations in the region.

DISCUSSION

Using satellite telemetry we were able to describe in detail the movements of individual PFP lesser sandhill cranes on summer range in Alaska, winter range in California, and through fall and spring migration. Whether the geographic range of all PFP cranes breeding in the Cook Inlet and Bristol Bay regions of Alaska is similar to that of our radioed cranes is uncertain. However, without exception, cranes captured in both locations followed the same migratory path and wintered in areas of the CVC that were small and well defined (Fig. 1).

Stopping, Staging and Wintering Areas

Our satellite transmitters were programmed to transmit more frequently during migration. We could not, however, precisely quantify the lengths of stay made by PFP cranes at stopping areas. Crane use may have gone partially or completely undetected because the area was visited at some point during the transmitters off cycle. Locations that were used for longer durations, however, were easily identified and, in relative terms, are probably more important to migrating cranes than locations used for shorter periods.

PFP lesser sandhill cranes completed migration from summer range in Alaska to winter range in the CVC in 13 to 40 days (Table 2). Both the minimum and maximum transit times were from individuals monitored during the fall in 2001 indicating that either cranes exhibit different migration strategies, or experienced different weather conditions. Weather conditions can affect movements of migrating cranes (Kessel 1984), and probably explain much of the variation exhibited by our radioed birds (Table 2).

More time was spent in Alaska during fall migration than other states or province (Table 2), but partly because Alaska makes up the largest proportion of the travel route. Stops in Alaska were, for the most part, of short duration (<2 days) with more extensive stopovers occurring at Gustavus and the Yakutat Forelands. That 80% of radioed cranes stopped at the Yakutat Forelands indicates that the area provides a desirable resource. The relatively high use of the Bering Glacier lowlands, Stikine and Copper River Deltas, and Gustavus indicates the importance of these areas to migrating cranes.

British Columbia also comprises a large proportion of the total migration route but most cranes spent relatively little time (≤5 days) in this province during fall and spring migration. As was the case in Oregon, a large proportion of locations obtained during the fall were of cranes during active migration and not at rest. Stopping areas were used for short durations and not easily identified with satellite transmitters programmed with on-off duty cycles. Most cranes migrated through these regions during the short duration of the transmitters off cycle, and were located a considerable distance along the migration route during the next transmission period.

The Pothole Reservoir region (Grant County), including the Columbia River National Wildlife Refuge in central Washington, received more use by radioed cranes than other locations along the migration corridor. This was more apparent in the spring when 70% of radioed birds used the area for 10–42 days. Staging areas in Washington, plus locations used for long periods in Oregon and Idaho are important to cranes in that they undoubtedly provide a large proportion of the nutritional resources used for the energetic demands of migration (Krapu 1987).

The geographic extent of PFP lesser sandhill cranes monitored during the winter was restricted to 2 primary locations within the CVC with little interchange between areas (Fig 1). With exception of the federal wildlife refuges and state wildlife areas in Merced County, most of the winter locations appear to be on private lands. This is especially true for cranes using lands in the Delta region. Future development of these wintering areas should be monitored closely because traditionally important roost and foraging areas may be limited (Pogson 1990).

Affinities Among Breeding and Wintering Areas

The western boundaries separating the breeding range of the PFP and the MCP are in close proximity. We, as did others (Pogson et al. 1988, U.S. Geological Survey 1998), found no evidence indicating that migration routes, and winter and summer range of these populations overlap.

While the upper Cook Inlet and Bristol Bay breeding populations may be geographically distant, we believe it is unlikely that they are genetically isolated. PFP cranes breeding in these areas utilize the same migration routes, staging and wintering areas. Additionally, the propensity for the juvenile segment of the population to disperse to other regions suggests that interchange of individuals between areas is likely.

Littlefield and Thompson (1982) previously described the geographic range of PFP lesser sandhill cranes. They separated the population into two segments based on differences in migration corridor and winter distribution. The migration route for the "western segment" included the Willamette Valley, Oregon, the Washington coast through Puget Sound, and the coast of British Columbia and Alaska. The migration route and wintering areas described by Littlefield and Thompson (1982) for the "eastern segment" of PFP lesser sandhill cranes was nearly identical to that used by cranes during this study. We found no evidence suggesting that PFP lesser sandhill cranes breeding in Cook Inlet and Bristol Bay use an all-coastal route along British Columbia and Washington state during migration. During the fall, radioed cranes left the coast near the Stikine River Delta in Alaska and used an interior route through central British Columbia, Washington and Oregon to wintering areas in the CVC. A reverse route was taken in the spring.

PFP cranes nesting on islands in southeast Alaska and along the coast of northern British Columbia are believed to be Canadian subspecies (Littlefield and Ivey 2002, Ivey et al., in prep). Preliminary evidence suggests that they follow a migration route, stage, and winter in areas similar to that described for the "western segment" of the PFP lesser sandhill cranes. It is likely that this coastal, Canadian component explains the geographical differences in range described by Littlefield and Thompson (1982) for the "western" and "eastern" segments of the PFP. No overlap appears to exist in the breeding range of PFP cranes captured in Bristol Bay and Cook Inlet (this study) with cranes breeding to the south along the Pacific Coast (Ivey et al., in prep). However, the possibility of gene flow between these populations warrants further study.

Petrula and Rothe (in review) present a more detailed report describing the movements and distribution of PFP lesser sandhill cranes.

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Table 1. Date and location deployed, age, sex, fate of bird, days active, and number and quality of locations received for satellite transmitters deployed on Pacific Flyway Population lesser sandhill cranes captured in Alaska in 2000, 2001 and 2002.

ID	Date deployed	Capture location	Age	Sex	Days active[a]	Fate[b]	Number of locations/class code 3	2	1	0	A	B	Total locations[c]
29302	7/18/00	Palmer Hay Flats	Colt	F	417	off air	15	27	71	163	57	77	418
29303	7/18/00	Palmer Hay Flats	Colt	M	77	unknown	3	6	13	28	29	24	104
29304	7/17/00	Anchorage Coastal Refuge	Colt	F	46	shot	2	0	2	16	4	10	47
29501	7/18/00	Palmer Hay Flats	Colt	M	55	depredated	4	5	23	30	36	38	137
29502	7/17/00	Anchorage Coastal Refuge	Colt	F	51	depredated	0	1	5	2	12	15	36
29503	7/18/00	Palmer Hay Flats	Colt	M	425	off air	8	36	79	318	142	170	793
33090	4/27/01	Matanuska Valley	Adult	M	96	unknown	2	8	30	67	32	35	177
33091	4/27/01	Matanuska Valley	Adult	U	131	unknown	2	11	49	62	42	50	218
33092	4/27/01	Matanuska Valley	Adult	M	487	off air	18	59	151	300	175	189	916
13381	7/28/01	Point McKenzie	Colt	F	373	off air	9	47	161	338	139	175	890
13385	7/28/01	Susitna Flats	Colt	M	38	depredated	1	5	20	43	22	23	116
13386	7/27/01	Anchorage Coastal Refuge	Colt	M	380	off air	13	28	88	167	98	131	546
13387	7/28/01	Palmer Hay Flats	Colt	F	401	off air	14	48	125	283	144	174	811
29501b	7/27/01	Anchorage Coastal Refuge	Colt	F	420	off air	11	34	107	265	151	183	770
29502b	7/27/01	Palmer Hay Flats	Colt	M	295	off air	8	24	82	154	60	82	417
13380	8/02/02	Nushagak Peninsula	Colt	F	61	unknown	5	16	50	103	63	76	315
13382	8/02/02	Nushagak Peninsula	Colt	M	361	off air	2	8	30	181	75	98	460
13385b	8/02/02	Nushagak Peninsula	Colt	M	423	off air	17	41	124	247	140	151	736
29304b	8/02/02	Nushagak Peninsula	Colt	M	87	unknown	1	12	54	141	67	87	363
35667	8/02/02	Nushagak Peninsula	Colt	F	52	unknown	6	16	38	92	42	58	260
35668	8/02/02	Nushagak Peninsula	Colt	F	18	unknown	0	0	0	2	2	3	7
35669	8/02/02	Nushagak Peninsula	Colt	M	53	unknown	7	17	34	38	61	53	213

[a] Number of days from transmitter deployment to date when fate determined.

[b] Sandhill cranes with unknown fates either carried a defective transmitter, shed the transmitter, or died. Cranes carrying satellite transmitters that went off-air did so at the anticipated end of battery life.

[c] Total includes locations with class code Z.

Table 2. Migration chronology for Pacific Flyway Population lesser sandhill cranes captured in upper Cook Inlet (2000 and 2001) and Bristol Bay (2002) regions of Alaska. X indicates where the satellite transmitter either failed; the bird died or shed the transmitter.

	Fall migration								Spring migration							
		Approximate no. days in:								Approximate no. days in:						
Year/ID	Begin	Alas.	B.C.	Wash.	Oreg..	Calif.	Arrive winter range	Total trip length	Begin	Calif.	Oreg.	Wash.	B. C.	Alas.	Arrive summer range	Total trip length
2000																
29302	9/6	16	2	11	2	2	10/8	33 days	3/7	3	39[a]	3	4	3	4/28	52 days
29303	9/7	14	2	1	X											
29503	9/7	14	1	9	2	1	10/3	27 days	3/4	5	1	46	4	3	5/1	59 days
2001																
33092	9/7	17	6	3	2	2	10/6	30 days	3/4	10	37[a]	2	5	4	4/30	58 days
13381	9/7	19	6	13	4	2	10/20	44 days	3/6	1	5	43	3	5	5/1	57 days
13386	9/8	15	8	4	2	1	10/7	30 days	3/20	1	4	32	3	5	5/3	45 days
13387	9/5	5	5	12	2	2	9/30	26 days	3/4	4	19	26	5	5	5/1	59 days
29501b	9/12	15	18	1	2	1	10/18	37 days	3/5	1	13	41	3	6	5/7	64 days
29502b	9/7	unk	unk	unk	unk	3	9/19	13 days	2/28	4	49	19	5	X		
2002																
13380	9/11	9	2	4	1	X										
13382	9/18	9	3	2	1	1	10/3	16 days	3/19	1	43	3	3	10	5/18	60 days
13385b	9/19	10	2	2	1	4	10/7	19 days	3/20	1	2	38	12	4	5/24	65 days
29304b	9/19	6	1	13	3	1	10/12	24 days	X							
35667	9/8	6	4	1	1	X										
35669	9/16	9	X													
Average	9/11	12	5	6	2	2	10/7	27 days	3/9	3	21	25	5	5	5/6	58 days

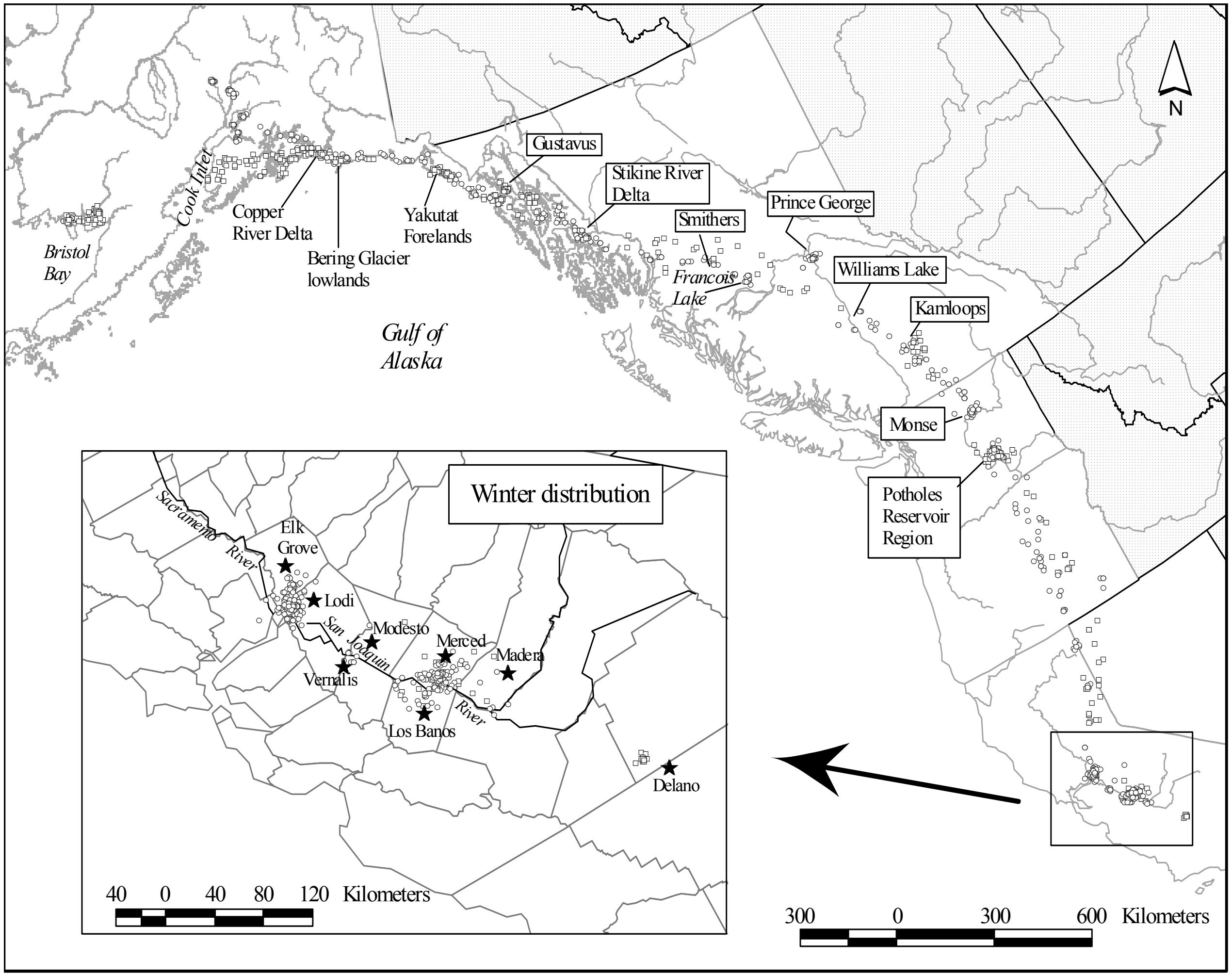
[a] Oregon-Idaho border.

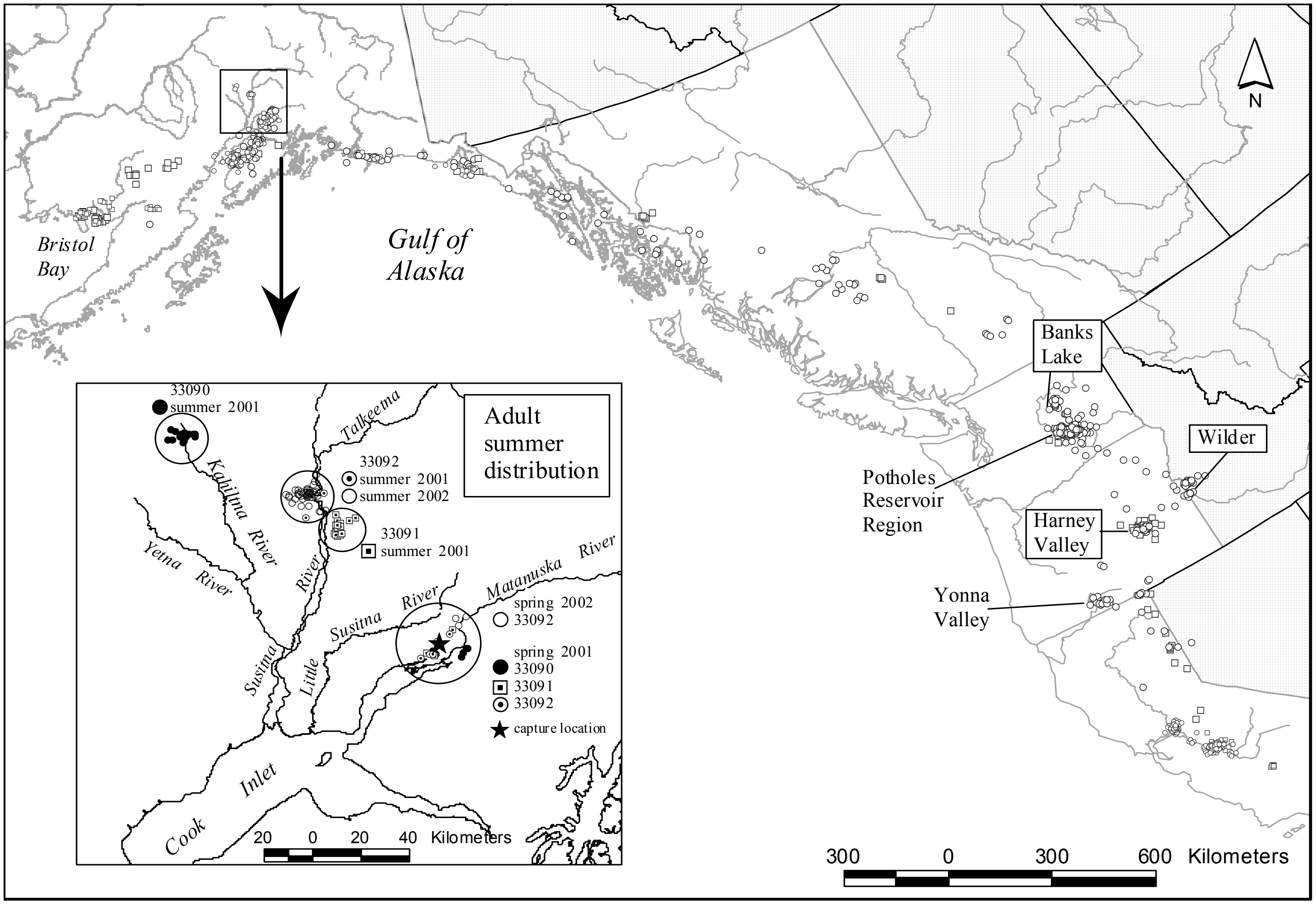
Table 3. Number of duty cycles[a] present and approximate area (km^2) of home range for individual Pacific Flyway lesser sandhill cranes at specific locations in the Central Valley of California during the winter in 2000, 2001 and 2002.

	Delta region		near Vernalis		near Merced		near Delano	
Crane ID	Home range	No. of cycles	Home range	No. of cycles	Home range	No. of cycles	Home range	No. of cycles
13381	124	36	0	2	0	0	0	0
13382	0	0	0	1	2,060	39	0	0
13385	7	12	0	0	369	9	40	27
13386	0	0	0	0	2,332	48	0	0
13387	119	40	0	0	758	10	0	0
29302	239	30	0	0	67	6	0	0
29501	329	40	0	1	0	0	0	0
29502	46	8	0	0	539	43	0	0
29503	371	44	0	0	0	0	0	0
33092	106	29	45	8	0	0	0	0

[a] Satellite transmitters cycled on for 6-8 hrs every 96-106 hrs during the winter.

List of Figures


Gustavus
Stikine River Delta
Smithers
Prince George
Williams Lake
Kamloops
Monse
Potholes Reservoir Region
Cook Inlet
Bristol Bay
Copper River Delta
Bering Glacier lowlands
Yakutat Forelands
Francois Lake
Gulf of Alaska
N
Winter distribution
Sacramento River
Elk Grove
Lodi
Modesto
San Joaquin River
Merced
Madera
Vernalis
Los Banos
Delano
40 0 40 80 120 Kilometers
300 0 300 600 Kilometers


Bristol
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300 0 300 600 Kilometers
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33090
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capture location
Talkeetna
Kahiltna River
Yetna River
River
Susitna
Little
Susitna River
Matanuska River
Cook Inlet
20 0 20 40 Kilometers